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# REVIEW ON ACHYRANTHES ASPERA L.

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**Introduction to famity: Amaranthaceae**
Amaranthaceae is s small compact family having 65 genera and 850 sps, extensively distributed in tropical and temperate region of the globe. The family is very well represented in tropical America, Africa and India. In our country Amaranthaceae is represented by 17 genera and more than 50 sps chiefly occurring in warmer regions. Members of this family are mostly herbs or shrubs. Leaves are usually hairy, inflorescence usually hairy, spike head or cymose panicle, flowers bisexual with membranous perianth, bracts and bracteoles. Perianth 5, antisepalous, ovary superior, bicarpellary, syncarpous, monolocular, with a single basal ovule. Fruit is a one seeded nut or utricle, seeds have a mealy endosperm. (Kiritkar and Basu et al., 1975)

**Introduction to genus: *Achyranthes***
Herbs with opposite, petiolate, entire leaves. Inflorescence a more or less slender spike, terminal on the stem and branches, the flowers at first congested and patent, finally usually laxer and deflexed; bracts deltoid or ovate, the midrib excurrent in a spine. Flowers solitary in the bracts, hermaphrodite, bibracteolate. Bracteoles spmous-aristate with the excurrent midrib, the lamina forming short and free to longer and adnate membranous wings. Stamens 2-5, filaments filiform, monadelphous, alternating with quadrate to broadly quadrate-spathulate pseudostaminodes, these are simple and dentate or fimbriate, or commonly furnished with a variably developed dorsal scale; anthers bilocular. Style slender, stigma small, truncate-capitate. Ovary with a solitary pendulous ovule, the ovary wall very thin in fruit. Entire flower with bracteoles falling with the ripening of the cylindrical seed, the deflexed bracts persistent. Endosperm copious. (Kiritkar and Basu et al,, 1975)

There are seven species of *Achyranthes*:
(1) *Achyranthes aspera*
(2) *Achyranthes atollensis*
(3) *Achyranthes bidentata*
(4) *Achyranthes canescens*
(5) *Achyrathes japonica*
(6) *Achyranthes splendens*
(7) *Achyranthes mutica*

***Achyranthes aspera* Vernacular names:**
**English** - Prickly Chaff Flower.

**Ayurvedic-** Apaamaarga, Chirchitaa, Shikhari, Shaikharika, Adahshalya, Mayura, Mayuraka, Kharamanjari, Kharapushpaa, Pratyakpushpaa, Aaghaat, Vashira, Kanihi.

**Unani** -Chirchitaa.

**Siddha/Tamil-** Naayuruvi.

**Folk** - Chirchitta, Chichidaa, Latjeeraa.

**Habit and Habitat**
An erect or procumbent, annual or perennial herb, often with woody base commonly found as a weed on waysides and waste places throughout India up to an altitude, 2100 m.

**Plant description:**
Main root, long cylindrical, thick, secondary and tertiary roots present, slightly ribbed, yellowish brown in colour, odour slight; taste slightly sweet and mucilaginous. Stem yellowish brown, erect, branched, cylindrical, solid, about 60 cm high. Leaves petiolate, alternate, elliptic-obovate or sub-orbicular, acute, entire, pubescent above and usually white woolly beneath. Flowers greenish-white, in small dense axillary heads orspikes. Bracts and bracteoles persisting, ending in a spine. Seeds subcylindric, truncate at the apex, rounded at the base, black and shining.

**Uses:**
The plant is reported to be pungent, astringent, pectoral and diuretic. It is used as an emmenagogue, in piles and skin eruption. The decoction of the plant is useful in pneumonia and renal dropsy while the juice of the plant is used in opthalmia and dysentery. The leaves are used in the treatment of gonorrhoea, and excessive perspiration. The extract is used for leprosy and the heated sap for tetanus. The root is astringent, the paste is applied to clear opacity of cornea, and for wound healing purposes. The root is also reported to be useful in cancer. A decoction of the root is used for stomach troubles and aqueous extract is used in bladder stones. The flowers, ground and mixed with curd and sugar, are given for menorrhagia. The flower tops are stated to be employed for the treatment of rabies. The seeds are said to be emetic and used in hydrophobia (Ganguly et al., 2004).

**Phytochemical reviews:**
The plant was reported to yield a water-soluble base and chloroform soluble base. The former was earlier designated as achyranthine (Basu et al., 1957a) and was characterized as a betaine derivative of N-methylpyrrolidine-3-earboxylic acid (Basu, 1957b). Studies (kapoor and singh 1967) showed that water-soluble base was betaine and not achyranthine. The chloroform soluble basic fraction was shown to be a mixture of two uncharacterized alkaloidal entities (Kapoor and Singh, 1967). The ethanol extract of the plant contained alkaloids and saponins while flavanoids and tannins were found absent( Kumar et al., 1990). The shoot yielded a new aliphatic dihydroxyketone, characterized as 36, 47- dihydroxyhenpentacontan-4-one together with tritriacontanol (Misra et al., 1991); an essential oil; a new long chain alcohol characterized as 17-pentatriacontanol (Misra et al., 1992); four new compounds characterized as 27-eycloheptacosan-7-oleanolic acid, 16- hydroxy-26-methylheptacosan-2-one ( Misra et al.,1993), 4-methylheptatriacont-l-en-10- ol and tetracontanol-2 (Misra et al., 1996). Various parts of the plant, viz, seeds, stem, leaves (Baneiji et al., 1971) and root ( Baneiji and Chadha, 1970) were reported to contain ecdysterone. The chloroform extract of the stem led to the isolation of pentatriacontane, 6-pentatriacontanone, hexatriacontane and triacontane (Ali, 1993). The hydrosylate contained the usual aminoacids. The values obtained for ten essential amino acids and cystine showed that the seed protein compared favourably with Bengal gram in its leucine, isoleucine, phenylalanine and valine content, while its tryptophan and sulphur amino acid (methionine and Cystine) content were higher than most of the pulses. It was, however, deficient in arginine, lysine and threonine as compared to whole egg protein. (Hemalatha et al., 2008). The defatted seeds were reported to yield a saponins in an yield of 2 per cent which was identified as oleanolie acid-oligosaccharide. The sugar moiety of the saponins was composed of glucose, galactose, xylose and rhamnose (Gopalachari and Dhar, 1952, 1958). From the seeds, oleanolie acid was isolated (Khastgir 1958). Later, investigation led to the isolation of two oleanolie acid based saponins, saponins A and saponin B which were characterized as a-a-rhamnopyranosyl (1→4)-ß-D-glucopyranosyl (1→4)-ß-D-glucuronopyranosyl (1→3)-

oleanolic acid and ß-D-galactopyranosyl (1→28)ester of saponin A, respectively (Hariharan and Rangaswamy, 1970). In another study, the total saponins were hydrolyzed with acid and the genin was identified as oleanolie acid (Batta and Rangaswami, 1973). A rapid procedure for the separation of triterpenoid saponins based on partition chromatography from the plant has been described (Sarkar and Rastogi, 1960). The seeds contained hentriacontane, 10-octacosane, 10-triacosanone and 4-tritriacontanone(Ali,1993). The fatty oil constituent of the seed oil comprised of lauric, myristic, palmitic, stearic, arachidie, behenic, oleic and linoleic acids. (Daulatabad and Ankalgi, 1985).

The unripe fruits yielded two new saponins (C and D) which were identified as ß -D-glucopyranosyl ester of a-L - rhamnopyranosyl (1→4)-ß –D- glucuranopyranosyl (1→3) leanolic acid and ß -D-glucopyranosyl ester of a –Lrhamnopyranosyl (1 →4)-p -D-glucopyranosyl (1→4)-ß –D-glucuranopyranosyl(l→3)oleanolic acid (Sheshadri et al., 1981). The chemical constituents of the root varied in different preliminary studies carried out. The root was found to contain oleanolic acid as the aglycone from the saponin fraction (Khastgir and Sengupta, 1958). Both root and shoot of the plant were found to contain saponins and lkaloids but no flavanoids (Sinha and Dogra, 1985). In another study, the root of the plant was found to contain alkaloids but indicated absence of saponins and tannins (Joshi and Sabnis, 1989). In yet another preliminary chemical study, the root was reported to contain alkaloids, flavanoids, saponins, steroids and terpenoids. Glycosides were found to be absent (Agrawal et al., 1989). Isolation of ß-sitosterol was also reported from the root (Misra et al., 1993). Three bisdesmosidic saponins(ß-Dglucopyranosl3-(O-α-L-rhamnopyranosyl (1→3)(O-ß-D-glucopyranosyloxy)oleanolate, (ß-D-glucopyranosyl3-(O-ß-D-galactopyranosyl(l→2)(O-ß-D-glucopyranosyloxy) oleanolate and ß-D-glucopyranosyl 3-(0-P-D-glucopyranosyloxy)oleanolate, 20-hydroxyecdysone, a steroid and quercetin-3-O-ß -D-galactoside was isolated from the aerial parts of A.aspera growing in Africa, particularly in Ethiopia.(Olaf K et al 2000). 3- Acetoxy-6-benzoyloxyapangamide has been isolated from an ethyl acetate extract of the stem of *Achyranthes aspera* (Muhammed et al, 2005)

**Pharmacology:**
The mixture of saponins isolated from the seeds caused a significant increase in force of contraction of the isolated heart of frog, guinea pig and rabbit. The stimulant effect of the lower dose (1 to 50 pg) of the saponins was blocked by pronethalol and partly by mepyramine. The effect of higher dose was not blocked by pronethalol. The saponins increased the tone of the hypodynamic heart and also the force o f contraction of failing papillary muscle. The effect was quicker in onset and shorter in duration in comparison to that exerted by digoxin( Gupta et al., 1972a). The effect of saponins on the phosphorylase activity o f the perfused rat heart has been investigated and compared with that of adrenaline. The saponin has been found to stimulate the phosphorylase activity of the heart and its effect was comparable to that of adrenaline. The ethanolic extract of the plants (Dhar et al., 1968) and leaves (Aswal et al., 1996) were screened for preliminary biological activities. The former extract showed hypoglycemic activity in rat. It was devoid of antibacterial, antifungal, antiprotozoal, anthelmintic, antiviral and anticancer activities and effects on isolated guinea pig ileum, respiration, CVS and CNS in experimental animals. The leaf extract was found to be devoid of antiprotozoal and antiviral activities and effects on respiration, CVS and CNS in experimental studies. The LD50 o f the latter extract was > lOOOmg/Kg i.p. in mice ( Aswal et al., 1996)

**Antifertility**
The alkaloidal fraction obtained from the alcoholic extract of the root bark inhibited the response of oxytocin in isolated rat uterus. This fraction did not inhibit the responses to serotonin and acetylcholine in rat uterus and to histamine in guinea pig uterus (Gupta and Khanijo, 1970).The crude benzene extract of the stem was found to have potent abortificient effect in mice( Pakrashi et al., 1975). In an attempt to locate the active principle, various chromatographic fractions were tested for antifertility activity in female mice. The maximal activity was found to be located in the fraction eluted with 50 percent benzene in petroleum ether (Pakrashi et al., 1975b). The benzene extract of the plant (excluding root) also revealed antiimplantation activity in female albino rats (Mathur et al., 1983). The ethanolic extract of the plant showed anti-fertility activity on early pregnancy in rats. Further, the plant also showed potent activity at secondary testing level( Prakash et al., 1987). The methanolic extract of the root revealed anti-implantation activity in rats while the acetone extract of the root prevented implantation in rats (Prakash, 1986)

**Anti-inflammatory activity:**
The water soluble alkaloid achyranthine was screened for its anti-inflammatory and antiarthritic activity against carragennin induced foot oedema, granuloma pouch, formalin induced arthritis and adjuvant arthritis in rats. It showed significant anti-inflammatory activity in all the four models employed but less active than phenylbutazone and betamethasone. Further, achyranthine significantly reduced the weight of adrenal gland, thymus and spleen and raised the adrenal ascorbic acid and cholesterol contents. The effects were qualitatively similar to betamethasone. All the three drags tested reduced food intake but had no significant effect on urinary and fecal output and on mortality rate. Incidence of gastric ulcers was maximum with betamethasone and minimum with achyranthine (Neogi et al., 1969)

**Diuretic activity:**
Earlier studies (Bhide et al 1958) on potassium diuretics indicated that the diuretic activity of the ash of the plant may be due to high potassium (44 percent) content. Effect of a saponin isolated from the seed on urine output in albino rats has been investigated in comparison to mersalyl and acetazolamide. The saponins caused significant increase in urine rats. The diuretic affect was comparable to that observed with 3mg/Kg dose of mersalyl. The diuretic effect of the saponins, like acetazolamide was associated with an increase in the excretion of sodium and potassium in the urine (Gupta et al., 1972b)

**Antimicrobial:**
The aqueous solution of the base achyranthine as well as the entire plant showed antibacterial activity against *Staphylococcus aureus, Streptococcus haemolyticus* and *Bacillus typhosus* (Basu et al., 1957b) while the alcoholic and the aqueous extract of the leaves showed antibacterial activity against *Staphylococcus aureus* and *Escherichia coli* (George et al., 1947). The seeds growing on cattle dung revealed antibacterial activity against bacterial strains of *Bacillus subtilis, Pseudomonas cichorii* and *Salmonella typhimurium* (Sushil Kumar et al., 1997). In another study, ethanolic extract of the leaves and stem of the plant inhibited *Bacillus subtilis* and *Staphylococcus aureus* bacterial strains (Valsaraj et al., 1997). The aqueous leaf extract in in-vivo studies showed antibacterial activity against *Proteus vulgaris*. The extract was inactive against *Klebsiella aerogenes, Pseudomonas aeruginosa* and *Escherichia* co//(Perumal Samy et al., 1998). The aqueous residues of another sample of the plant leaves were found devoid of any activity against *Alkaligenes viscolactis, Aeromonas hydrophilla, Cytophaga* sp., Vibrio parahaemolytica, viz *Damsela, Bacillus cereus* and *Streptococcus pyogenes* in addition to *Escherichia coli, Klebsiella aerogenes, Pseudomonas aeruginosa* (Perumal Samy et al.,1999). In another study, the extract of the leaves was found to be active against the isolated bacteria E.coli, S.citri and aerobic spore formers from soft drinks (Meera et al., 1999). The essential oil isolated from the shoot was reported to have antifungal activity against *Asperigillus cameus* at various concentrations. The oil showed inhibition of the mycelial growth (Misra et al., 1992). In comparative study o f herbal agents used for fumigation in relation to formalin, the plant reduced the microbial colony counts in air samples considerably (Bisht et al., 1988). The acetone, chloroform, ethyl acetate, hexane and methanol leaf extracts of *Acalypha indica, Achyranthes aspera, Leucas aspera, Morinda tinctoria* and *Ocimum sanctum* were studied against the early fourth-instar larvae of *Aedes aegypti* L and *Culex quinquefasciatus* Say. The larval mortality was observed after 24 h exposure. All extracts showed moderate larvicidal effects; however, the highest larval mortality was found in the ethyl acetate extract o f *A. aspera* In the present study, bioassay-guided fractionation of *A aspera* led to the separation and identification o f a saponin as a potential mosquito larvicidal compound, with LC50 value of 18.20 and 27.24 ppm against *A. aegypti* and C. *quinquefasciatus,* respectively. (Bhagavan et al., 2008).

**Anthelmintic:**
Alcoholic extract of the plant did not show any effect on human *Ascaris lumbricoides* in vitro (kaleysa Raj, 1975). The leaf extract showed mortality against *Meloidogyne javamca* (Nandal and Bhatti, 1983)

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